Westerly wind events and precipitation in the eastern Indian Ocean as predictors for El Niño: Climatology and case study for the 2002–2003 El Niño

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Received 19 February 2004; revised 24 June 2004; accepted 6 August 2004; published 19 October 2004.

[1] This study expands on recent work linking intraseasonal-to-seasonal variability in observed precipitation and wind from September to March in the eastern Indian Ocean with the initiation of El Niño events during the last 25 years. First, westerly wind burst (WWB) events are defined as days when westerly wind speeds averaged over 5°–15°S and 70°–100°E were greater than 1.5 standard deviations from the mean. The number of WWB days from September to March was high before the onset of the 1982–1983, 1991–1992, 1997–1998, and 2002–2003 El Niño events, but not the 1986–1987 El Niño. This study suggests that for the 1979–2002 period, variations in precipitation in the eastern Indian Ocean is a more robust predictor of El Niño onset than analyzed winds. On the basis of the work of *Curtis et al.* [2002], a real-time precipitation-based El Niño Onset Index is presented, which during the austral summer of 2001–2002 successfully predicted the 2002–2003 El Niño. The index focuses on the magnitude of 30–60 day oscillations and mean conditions in the precipitation field. Case studies of high-resolution satellite-based data sets of precipitation, wind, and sea surface temperature (SST) for the 2001–2002 season are examined to better understand how events in the Indian Ocean are linked to Pacific Ocean wind disturbances and SST changes. Twice during this season maxima in precipitation and zonal winds propagated eastward, the first near the equator and the second to the south. For the southern case, warm waters preceded heavy precipitation in the eastern Indian Ocean, which preceded strong westerly winds. A cooling of the sea surface followed the wind-rain system. This sequence of events moved through the ocean passage between Indonesia and Australia, suggesting a coupling of convection, wind, and sea surface temperatures on the timescale of days. These case studies provide a basis for how the east Indian Ocean variations are linked to subsequent events in the Pacific Ocean, including the initiation of El Niño events. *INDEX TERMS:* 3360 Meteorology and Atmospheric Dynamics: Remote sensing; 3359 Meteorology and Atmospheric Dynamics: Radiative processes; 3354 Meteorology and Atmospheric Dynamics: Precipitation (1854); 4522 Oceanography: Physical: El Nino; *KEYWORDS:* precipitation, El Niño, onset

Citation: Curtis, S., R. F. Adler, G. J. Huffman, and G. Gu (2004), Westerly wind events and precipitation in the eastern Indian Ocean as predictors for El Niño: Climatology and case study for the 2002–2003 El Niño, *J. Geophys. Res.*, *109*, D20104, doi:10.1029/2004JD004663.

1. Introduction

[2] There is an ongoing debate as to the usefulness of wind observations in predicting the development of El Niño events. Recent papers have argued whether or not the Madden-Julian Oscillation (MJO) [*Madden and Julian*, 1994] and/or westerly wind burst events act as a stochastic forcing for El Niño [e.g., *Kessler and Kleeman*, 2000; *Vecchi and Harrison*, 2000; *Zhang and Gottschalck*, 2002; *Fedorov*, 2002; *Fedorov et al.*, 2003; *Belamari et al.*, 2003]. Many of these studies have concentrated on the western Pacific. However, recently intraseasonal convective anomalies associated with the MJO have been tracked from the Indian Ocean to the western Pacific [*Jones et al.*, 2004]. Using a coarse 5° × 5°-resolution outgoing longwave radiation (OLR) data set as a proxy for convection, these authors did not find a significant relation between the MJO and the phases of El Niño/Southern Oscillation, although there was an enhancement of western Pacific wind speeds. However, *Krishnamurti et al.* [2000] suggest important teleconnections between the phase and amplitude of zonal winds over the near-equatorial southern Indian Ocean and the subsequent onset of El Niño events.

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0148-0227/04/2004JD004663$09.00